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Sampling and Analysis Plan for Phase 1 of the BC Cribs and Trenches Area Waste Sites Excavation-Based Treatability Test

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

United States Department of Energy
P.O. Box 550
Richland, Washington 99352

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Title: Sampling and Analysis Plan for Phase 1 of the BC Cribs and Trenches Area Waste Sites Excavation-Based Treatability Test

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EXECUTIVE SUMMARY

This sampling and analysis plan defines the data-collection requirements for Phase 1 of a treatability test designed to support remedy selection at the BC Cribs and Trenches Area waste sites. The treatability test will assess field conditions related to removal, treatment, and disposal of near-surface contamination present in representative waste sites (as many as two trenches and one crib) within the BC Cribs and Trenches Area waste sites.

The specific objective of the treatability test is to provide data that will support evaluation of the partial removal, treatment, and disposal alternative action described in DOE/RL-2004-66, *Focused Feasibility Study for the BC Cribs and Trenches Area Waste Sites*[1]. Following are the specific data-collection objectives for the treatability test:

- Obtain additional characterization data for the BC Cribs and Trenches Area waste sites to better define the nature and extent of contamination in the near-surface soil at the waste sites
- Obtain data on the cost of conducting soil removal, treatment, and storage to support cost estimates for this remedial-action alternative for all of the BC Cribs and Trenches Area waste sites
- Correlate predicted dose information (obtained by modeling worker exposure using preexcavation site-characterization data) to actual dose received during conduct of the treatability test
- Enhance the removal, treatment, and disposal process to ensure that the dose to workers remains as low as reasonably achievable while conducting this remedial-action alternative

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[1] DOE/RL-2004-66, *Focused Feasibility Study for the BC Cribs and Trenches Area Waste Sites*, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

- Refine the process for downblending highly contaminated soil with less contaminated material to ensure that the requirements specified in BHI-00139, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*,[2] can be met while producing remediation wastes at a high production rate.

- Assess the integrity of remnant crib structure and collect information concerning void space to evaluate the potential for subsidence, which could affect evaluation of remedial alternatives.

Phase 1 of the treatability test is focused on the 216-B-26 Trench, where at least 30 shallow boreholes will be installed to collect information to better define the nature and extent of the near-surface contamination, which comprises primarily Cs-137 and Sr-90. Each of the boreholes will be geophysically characterized using spectral gamma logging to establish the distribution of Cs-137. Soil samples will be collected at specific depths from 24 of the boreholes to establish the Sr-90 distribution. Analysis of the data is expected to allow refinement of the previously calculated worker radiation-dose estimate (DOE/RL-2004-66) and estimate the total Cs-137 and Sr-90 inventories in the trench.

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[2] BHI-00139, 2002, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*, Rev. 4, Bechtel Hanford, Inc., Richland, Washington.

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FIGURES

TABLES

TERMS

ALARA	as low as reasonably achievable
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
COC	contaminant of concern
DOE	U.S. Department of Energy
DPT	direct-push technology
DQO	data quality objective
DR	decision rule
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FFS	focused feasibility study
G/P	glass or plastic
GEA	gamma energy analysis
GPC	gas-proportional counter
HEIS	*Hanford Environmental Information System*
HPGe	high-purity germanium
LSC	liquid scintillation counter
N/A	not applicable
NaI	sodium iodide
OU	operable unit
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RL	DOE, Richland Operations Office
SAP	sampling and analysis plan
SGL	spectral-gamma logging
SIM	soil-inventory model
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*, Ecology et al., 1989, as amended

METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If you know	*Multiply by*	*To get*	*If you know*	*Multiply by*	*To get*
Length			**Length**		
inches	25.40	millimeters	millimeters	0.0394	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles (statute)	1.609	kilometers	kilometers	0.621	miles (statute)
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.0929	sq. meters	sq. meters	10.764	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.591	sq. kilometers	sq. kilometers	0.386	sq. miles
acres	0.405	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.349	grams	grams	0.0353	ounces (avoir)
pounds	0.454	kilograms	kilograms	2.205	pounds (avoir)
tons (short)	0.907	ton (metric)	ton (metric)	1.102	tons (short)
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.034	ounces (U.S., liquid)
tablespoons	15	milliliters	liters	2.113	pints
ounces (U.S., liquid)	29.573	milliliters	liters	1.057	quarts (U.S., liquid)
cups	0.24	liters	liters	0.264	gallons (U.S., liquid)
pints	0.473	liters	cubic meters	35.315	cubic feet
quarts (U.S., liquid)	0.946	liters	cubic meters	1.308	cubic yards
gallons (U.S., liquid)	3.785	liters			
cubic feet	0.0283	cubic meters			
cubic yards	0.764	cubic meters			
Temperature			**Temperature**		
Fahrenheit	(°F-32)*5/9	Centigrade	Centigrade	(°C*9/5)+32	Fahrenheit
Radioactivity			**Radioactivity**		
picocurie	37	millibecquerel	millibecquerel	0.027	picocurie

1.0 INTRODUCTION

This sampling and analysis plan (SAP) describes the sampling and analysis required to achieve the data quality objectives (DQO) specific to characterization of the 216-B-26 Trench, as documented in DOE/RL-2007-15, *Excavation-Based Treatability Test Plan for the BC Cribs and Trenches Area Waste Sites*, Appendix A, draft. The activities described in DOE/RL-2007-15 are required to support appropriate remedy selection for near-surface contamination at the BC Cribs and Trenches Area waste sites. This SAP addresses the elements of a quality assurance project plan (QAPjP) and field sampling plan as outlined in EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5. This SAP also will ensure compliance with the quality assurance/quality control (QA/QC) requirements of the Hanford Site; the U.S. Department of Energy (DOE), Richland Operations Office (RL); and the U.S. Environmental Protection Agency (EPA), as referenced in applicable documents throughout this SAP.

The treatability test provides data to support a decision regarding the partial removal, treatment, and disposal remedial alternative for near-surface soil, as described in DOE/RL-2004-66, *Focused Feasibility Study for the BC Cribs and Trenches Area Waste Sites* (FFS). The activities described in this SAP involve soil sampling and analysis and spectral-gamma logging (SGL) in boreholes installed in the 216-B-26 Trench within the BC Cribs and Trenches Area waste sites, using direct-push technology (DPT). The data collected in the 216-B-26 Trench will be used to determine the nature and extent of Cs-137 and Sr-90 near-surface contamination, to estimate the amount of material requiring removal (i.e., define the lateral and vertical extent of the excavations), and to calculate a predicted dose associated with radiological risks encountered during excavation activities. Other data generated during subsequent phases of the treatability test (1) will determine the actual dose received by personnel conducting partial-removal treatment and disposal of soil at the selected waste sites and (2) will ensure that the requirements of BHI-00139, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*, are met for disposal of contaminated soil wastes. The results of the treatability test will support the remedy selection process that will be documented in a revision to DOE/RL-2004-66 and ultimately in the record of decision issued by the EPA.

1.1 BACKGROUND

The BC Cribs and Trenches Area waste sites include 6 cribs, 20 trenches, a siphon tank, and a pipeline. All of these waste sites are included in the 200-BC-1 Operable Unit (OU). These waste sites received more than 117,000 m^3 (31 Mgal) of radioactive liquid waste that was discharged to the soil. Discharges to these liquid-waste disposal sites were limited to avoid exceeding the estimated capacity of the soil to retain the liquid above the water table.

Sixteen of the 20 trenches (including the 216-B-26 Trench) and all of the cribs received scavenged waste from the uranium recovery process and the ferrocyanide processes at the 221/224-U Plant, which recovered uranium from the metal waste streams originating from the B Plant and T Plant. This waste is described as "scavenged," because most of the highly radioactive Cs-137 was chemically removed. The scavenged-waste discharges contributed the largest liquid fraction of contaminants discharged to the ground in the 200 Areas. The other four trenches in the BC Cribs and Trenches Area waste sites were formerly in the 200-LW-1 OU. These four trenches originally were assigned to the 200-LW-1 OU because three of the four trenches received waste from the 300 Area laboratory facilities and the 340 Waste Neutralization Facility. The fourth trench received waste from the Plutonium Recycle Test Reactor.

Figure 1-1 shows the locations of the 200 West and 200 East Areas on the Hanford Site and the location of the BC Cribs and Trenches waste sites. Figure 1-2 shows the distribution or layout of these waste sites within the BC Cribs and Trenches Area.

Although the cribs and trenches are similar in that both are liquid-waste disposal sites, they have distinct differences. The cribs are relatively small (12.2 m [about 40 ft] square at the bottom) and were designed to disperse the liquid waste evenly throughout the crib. The cribs received waste in large quantities (approximately 42,000 L [about 11,000 gal] at a time) from the 200-E-14 Siphon Tank, which functioned as a large "toilet." When full, the siphon tank automatically flushed its contents through a 36 cm (14-in.-) diameter pipe to a crib. In contrast, the trenches typically were 153 m (500-ft-) long narrow, open excavations that were fed liquid waste through a network of aboveground 5.1 cm (2-in.-) diameter pipes placed at infrequent intervals along the length of the trench. Thus, the trenches received uneven contaminant distribution along their length. Figure 1-3 illustrates the general features of the cribs, trenches, and siphon tank. An aerial photograph (Figure 1-4) shows the BC Cribs and Trenches during construction.

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), also known as Superfund, requires remedial action for these trenches, cribs, siphon tank, and pipeline. The proposed alternative actions for the BC Cribs and Trenches Area waste sites are presented in DOE/RL-2004-66. The FFS evaluates the potentially applicable remedial alternatives and the feasibility of each alternative against nine criteria specified in CERCLA. This evaluation will determine a preferred alternative for each of the BC Cribs and Trenches Area waste sites. One of the alternatives examined in the FFS is removal, treatment, and disposal of all (or a portion) of the contaminated soil in the BC Cribs and Trenches waste sites.

Summary information for the 216-B-26 Trench waste site is provided in Table 1-1. It is known that the length of the trench was divided into thirds by berms. Therefore, it is possible that different amounts of waste were received in each one-third of the trench. No piping was left in place after closure of the 216-B-26 Trench. The same pipe was used in all of the BC trenches and moved from one trench to another. Therefore, it is not known where the exact discharge points in this trench were. Because the nature and extent of the contamination associated with the BC Cribs and Trenches Area waste sites is not well known, a treatability test is required to aid in further defining the feasibility of this remedial-action alternative. The data collected during the treatability test will be used to ensure that the conceptual site model and conclusions of the FFS are accurate concerning removal, treatment, and disposal of contaminated soil at the BC Cribs and Trenches Area waste sites.

Figure 1-1. Locations of the 200 West and 200 East Areas and the BC Cribs and Trenches Area Waste Sites on the Hanford Site.

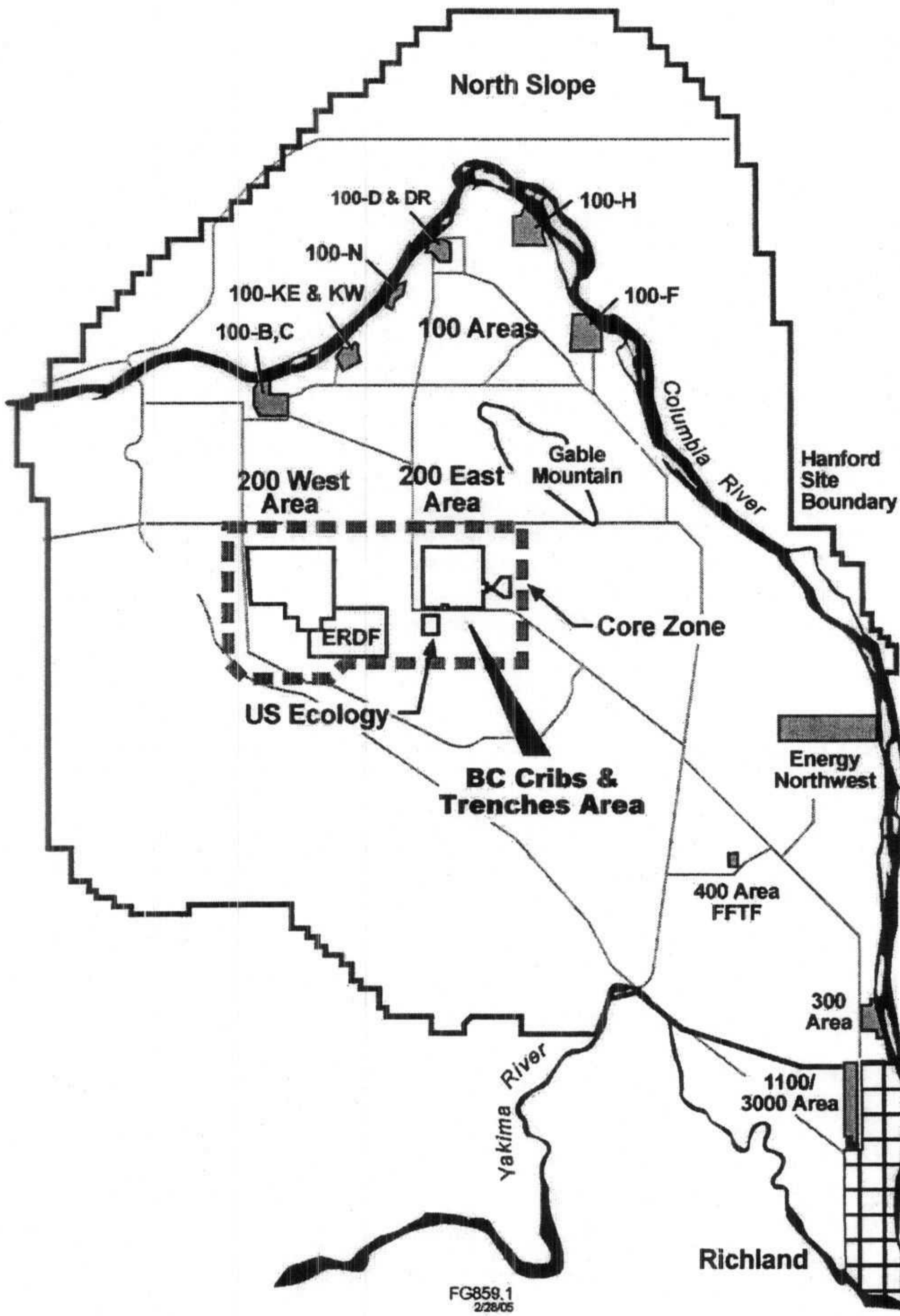
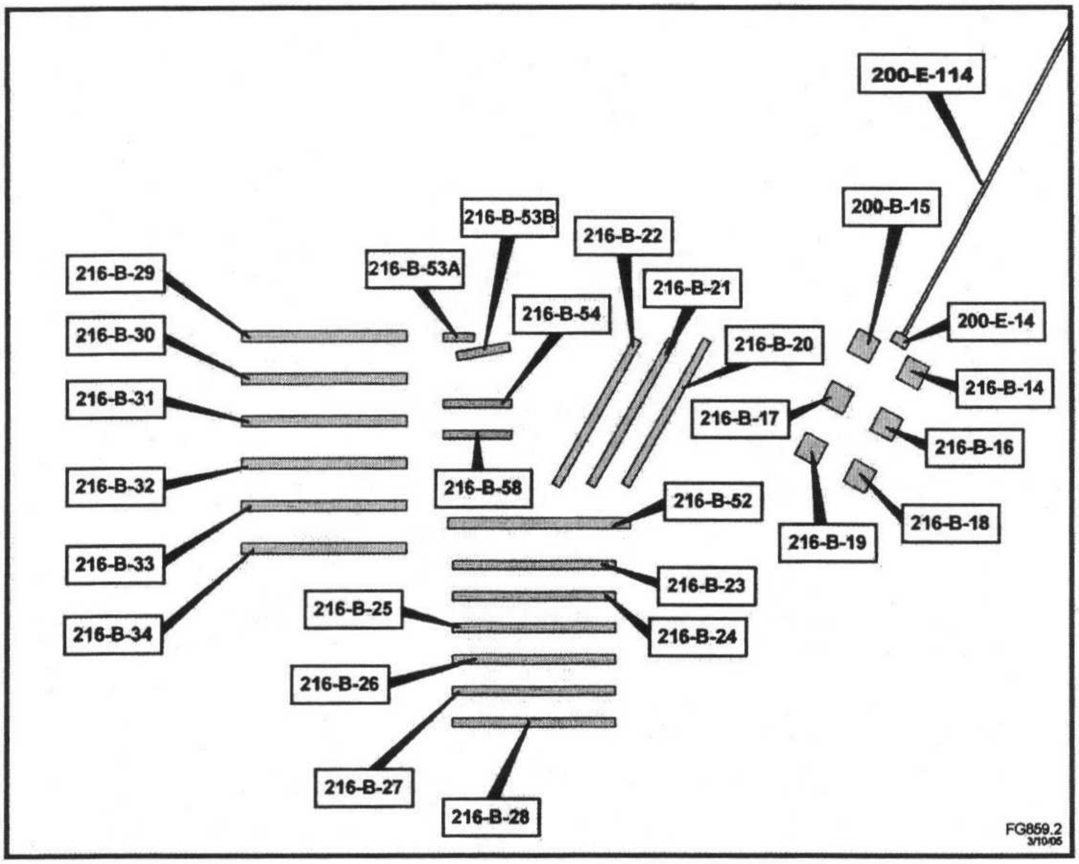


Figure 1-2. Distribution and Layout of the BC Cribs and Trenches Area Waste Sites.



Waste Site	Structure Type	Waste Site	Structure Type
216-B-14	Crib	216-B-28	Trench
216-B-15	Crib	216-B-29	Trench
216-B-16	Crib	216-B-30	Trench
216-B-17	Crib	216-B-31	Trench
216-B-18	Crib	216-B-32	Trench
216-B-19	Crib	216-B-33	Trench
216-B-20	Trench	216-B-34	Trench
216-B-21	Trench	216-B-52	Trench
216-B-22	Trench	216-B-53A	Trench
216-B-23	Trench	216-B-53B	Trench
216-B-24	Trench	216-B-54	Trench
216-B-25	Trench	216-B-58	Trench
216-B-26*	Trench	200-E-14	Siphon Tank
216-B-27	Trench	200-E-114	Pipeline

*The 216-B-26 Trench is the focus of Phase 1 of the treatability test and this sampling and analysis plan.

Figure 1-3. Features of the BC Cribs and Trenches Area Waste Sites.

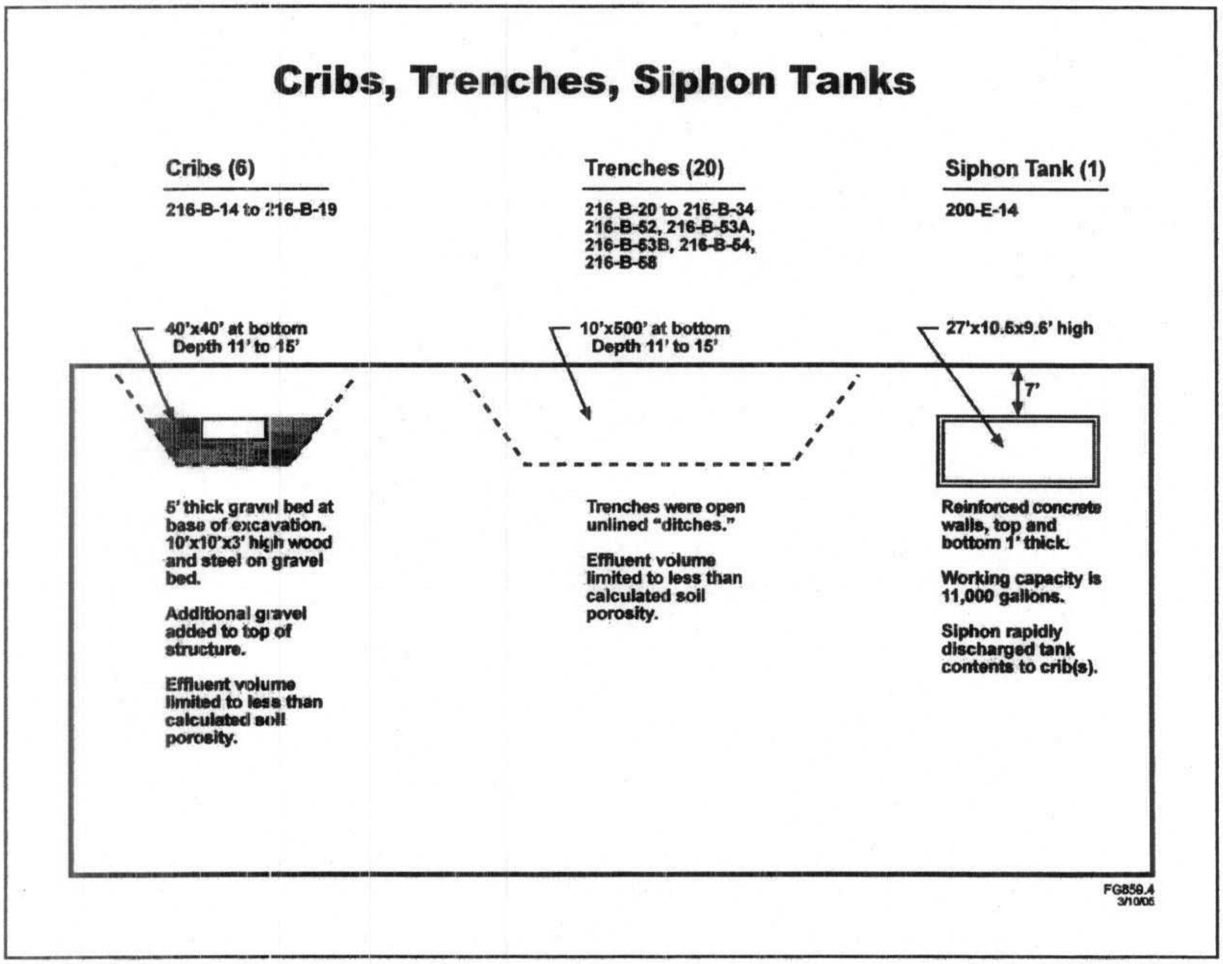


Figure 1-4. Construction of the BC Trenches in 1956.

Source: DOE/RL-2004-66, *Focused Feasibility Study for the BC Cribs and Trenches Area Waste Sites*, Draft A.

Table 1-1. Summary of Remedial Investigation/Feasibility Study Work Plan Information for the Trench 216-B-26 Waste Site.

Site Code	Site Name	Location	Dates of Operation	Source Facility	Contaminant/ Volume Released	Depth	Waste Site Dimensions	General Description
216-B-26	216-B-26 Trench 216-BC-13 Trench	Directly south of the 216-B-25 Trench, south of the 200 East Area (across Route 4S)	1956 to 1957		5,880,000 L with Fe, CN, Sr, PO_4, tributyl phosphate Surface radiological contamination	5.5 m (18 ft); 2.4 m (8 ft) is overburden		One of the unlined BC Trenches that was backfilled upon reaching capacity. The BC Trenches were stabilized together in 1969 with sand and gravel; in 1981 and1982 with clean soil. Concrete AC 540 markers outline the group of trenches. Uranium recovery process/scavenged liquid-extraction waste was routed to the trenches from the B, BX, and BY Tank Farms. Surface contamination spread through rabbits and vegetation has resulted in ongoing stabilization activities. Groundwater well 299-E13-12 monitors the site.

Source: DOE/RL-2000-38, *200-TW-1 Scavenged Waste Group Operable Unit and 200-TW-2 Tank Waste Group Operable Unit RI/FS Work Plan.*

During characterization activities previously conducted at the 216-B-26 Trench, six shallow (12.2 m [40-ft-] deep) holes spaced evenly along the length of the trench were installed to locate the region of the trench with the highest contamination. Gamma-radiation data were collected (i.e., logged) in these holes. Some portions of the trench appeared to be heavily contaminated, while other portions were only slightly contaminated. One of the shallow boreholes showed no contamination, suggesting that it intersected one of the two berms that divide the trench into thirds. Two boreholes were logged with Cs-137 concentrations in excess of 1 million pCi/g. The logs in two other boreholes exhibited maximum Cs-137 concentrations ranging from 20,000 to 60,000 pCi/g, and the log from one borehole indicated a maximum concentration of approximately 400,000 pCi/g Cs-137. The complete results associated with this characterization are described in Appendix F of the FFS (DOE/RL-2004-66).

A single borehole was drilled to groundwater at the place of highest contamination (based on the gamma-radiation logging of the evenly spaced shallow holes), and periodic soil samples were collected. The borehole also was logged to assess residual gamma-emitting radionuclides and moisture concentrations.

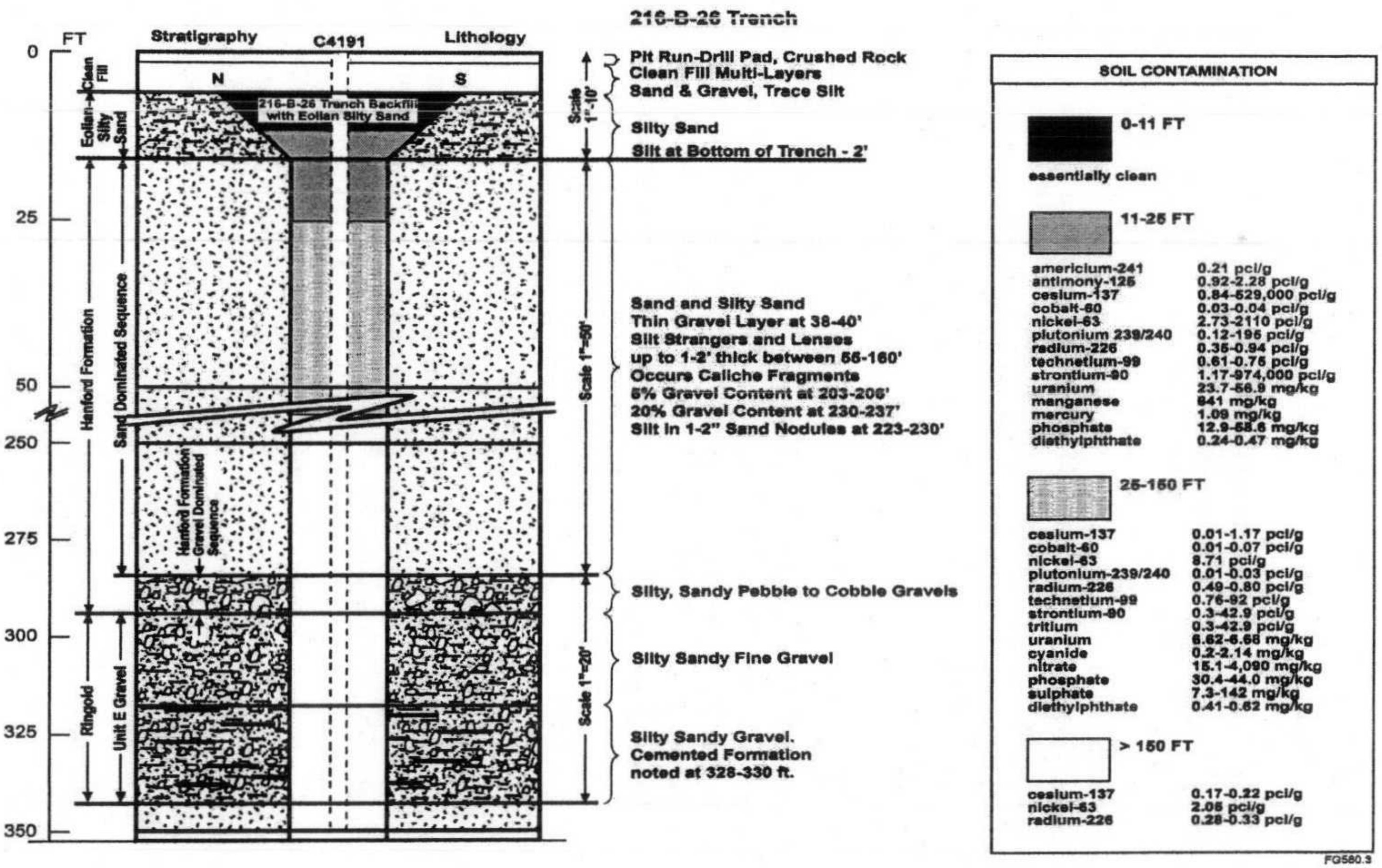
High concentrations of Cs-137 and Sr-90 are present near the surface, approximately 3.7 to 4.6 m (12 to 15 ft) deep. Their spatial distribution may be uneven, based on the shallow-borehole characterization described above. These contaminants are relatively immobile and are confined to near-surface soil.

The scope of the characterization described in this SAP will address near-surface contamination only. To provide a complete summary of known contamination associated with this waste site, a summary of the deeper contamination is included in the balance of this section. Elevated concentrations of Tc-99 and nitrate were found in fine-grained soil layers 30.5 to 39.6 m (100 to 130 ft) deep. Essentially no contamination was observed below 46 m (150 ft). Figure 1-5 depicts the contaminant distribution and summarizes characterization data.

Additional characterization based on measuring soil conductivity (a nonintrusive technology that reveals electrical properties that can be related to past waste discharges) rather than on soil sampling revealed that the Tc-99 and nitrate contamination has spread laterally beneath the 216-B-26 Trench and adjacent waste sites to where a continuous plume of contamination exists beneath the groups of trenches and beneath the cribs. A groundwater sample showed no contamination (DOE/RL-2004-69, *Proposed Plan for the BC Cribs and Trenches Area Waste Sites*, Draft A).

Figure 1-5. 216-B-26 Trench Contaminant Distribution Model of Contaminants of Potential Concern.

Source: DOE/RL-2004-66, *Focused Feasibility Study for the BC Cribs and Trenches Area Waste Sites.*



1.2 PROJECT SCOPE

The treatability test being conducted at the BC Cribs and Trenches Area waste sites will ensure that feasibility-study decisions concerning remedy selection are valid. The treatability test comprises four phases.

- In Phase 1, data will be collected in the 216-B-26 Trench concerning the nature and extent of Cs-137 and Sr-90 contamination. This trench is one of the 152 m (500-ft-) long trenches that received scavenged waste from the uranium recovery process and the ferrocyanide processes at the 221/224-U Plant. The data collected during Phase 1 will be used to estimate the amount of material requiring removal (i.e., define the lateral and vertical extent of the excavations) and to calculate a predicted dose that remediation workers will receive in Phase 2 of the treatability test. Data from this phase of the test also will be used to correlate the total curie content of Cs-137 in the trench, as determined by measurements and estimates of contaminated volume with the total Cs-137 content predicted by RPP-26744, *Hanford Soil Inventory Model, Rev. 1* (SIM). The activities described in this SAP address the characterization required to complete only Phase 1 of the treatability test.

- Phase 2 of the treatability test will involve excavation to test the process of removal, treatment, and disposal of the contaminated soil contained in the 216-B-26 Trench. Phase 2 of the test will begin with excavation of one-third of the total trench length. Data will be collected to ensure that Environmental Restoration Disposal Facility waste-acceptance criteria are met. Personal dose-monitoring devices will be used to measure worker dose. The actual dose measurements will be compared to the estimated dose to workers using the data collected during Phase 1. The process of soil treatment (downblending) to meet the Environmental Restoration Disposal Facility waste-acceptance criteria will be refined during this phase of the treatability test. Phase 2 of the test will include the option to cease excavation activities in the trench if the data collected from excavation of one-third of the trench are sufficient to allow decision makers to assess the feasibility of partial removal, treatment, and disposal for trenches in the BC Cribs and Trenches Area.

- Phase 3 of the treatability test will involve characterization, similar to that conducted in Phase 1, followed by excavation to remove, treat, and dispose of soil and residual structures in the 216-B-14 Crib. Data will be collected for the same purposes as those described in the first two phases. In addition, the potential for subsidence caused by failure of the remnant crib structure will be evaluated.

- Phase 4 of the test will involve characterization followed by excavation, treatment, and disposal of contaminated soil in the 216-B-53A Trench (formerly assigned to the 200-LW-1 OU). Data collected in Phase 4 also will support initial site characterization and waste characterization and will validate dose measurements with predicted dose.

The decision makers (RL and EPA) will review data as they are collected in each phase of the test. When sufficient data are collected to complete the assessed feasibility of the partial removal, treatment, and disposal remedial alternative, the treatability test may be concluded without completion and/or initiation of one or more of the phases listed.

1.3 CONTAMINANTS OF CONCERN

Through the DQO process, a systematic methodology is used to identify the contaminants of concern (COC) for each project. Data will be collected to characterize the nature and extent of contamination in the trench before excavation activities begin. Boreholes will be installed using DPT.

The COCs for the measurements to be obtained in this phase of the treatability test (before excavation and partial removal, treatment, and disposal of contaminated soil) in the 216-B-26 Trench are listed in Table 1-2.

Table 1-2. Phase 1 Contaminants of Concern for Measurement in the 216-B-26 Trench.

Contaminant	Measurement Method
Field Measurements	
Cesium-137	Gamma energy analysis using a borehole spectral-gamma logging instrument
Laboratory Measurements	
Cesium-137	Gamma energy analysis conducted on the 216-B-26 Trench soils
Total radioactive strontium	Gas-proportional counter or liquid-scintillation counter conducted on the 216-B-26 Trench soils

1.4 DATA QUALITY OBJECTIVES

The DQOs for the BC Cribs and Trenches Area waste sites were developed in accordance with EPA/240/B-06/001, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, guidance and were used as the basis for requirements in this SAP. This section summarizes the key outputs for the 216-B-26 Trench waste site resulting from the implementation of the multistep DQO process. Additional details and outputs of the DQO process for the entire treatability test are included in the DQO summary report (DOE/RL-2007-15, Appendix A).

1.4.1 Statement of the Problem

To support remedy selection at the BC Cribs and Trenches Area waste sites, the feasibility of the remedial-action alternative of partial removal, treatment, and disposal of near-surface contaminated soil must be assessed. Additional site-characterization data are required to better estimate the nature and extent of contamination and provide better estimates of the contamination and associated radiological risks that will be encountered during excavation activities. Other data are required to support the scope of the entire treatability test. Those data are specified in DOE/RL-2007-15.

1.4.2 Decision Rules

Decision rules (DR) are developed from the combined results of DQO Steps 2, 3, and 4. These results include the principal study questions, decision statements, remedial-action alternatives, data needs, COC action levels, analytical requirements, and scale of the decision(s). Decision rules generally are structured as "IF…THEN" statements that indicate the action that will be taken when a prescribed condition is met. Decision rules incorporate the parameters of interest (e.g., COCs), the scale of the decision (e.g., location), the preliminary action level (e.g., COC concentration), and the resulting action(s). Of the six decision rules developed for the treatability test, only DR #1 and #2 are applicable to the data that will be collected during Phase 1 activities in the 216-B-26 Trench using this SAP. These two DRs are summarized in Table 1-3.

Table 1-3. Decision Rules Applicable to Phase 1.

DR #	Decision Rule
1	*If* the field measurements for gamma-emitting radionuclides indicate the presence of Cs-137 at a concentration greater than 750 pCi/g, or laboratory measurements for Sr-90 indicate a concentration greater than 90,000 pCi/g, in the 216-B-26 Trench, *then* additional characterization data will be obtained to further establish the nature and extent of contamination. Otherwise, excavation parameters (e.g., volume of material, dimensions and coordinates of excavated surface) will be determined without precise site-characterization data concerning the vertical and lateral extent of contamination.
2	*If* the true mean concentration for applicable radionuclide constituents agrees with the concentration predicted by using the inventory inputs for the soil-inventory model (as represented by the inventory value being within the 95% confidence interval around the sample mean), *then* the soil-inventory model will be considered valid for use in determining the inventory present in all of the BC Cribs and Trenches Area waste sites. Otherwise, additional characterization data will be collected or models will be modified to show adequate correlation between characterization data and inventory data.

DR = decision rule.

1.4.3 Sample Design Summary

The primary purpose of DQO Step 6 is to determine which DRs, if any, require a statistically based sample design. For those DRs requiring a statistically based sample design, DQO Step 6 defines tolerable limits on the probability of making a decision error.

Changes to the sampling design may be required because of unexpected field conditions, new information, health and safety concerns, or other unforeseen conditions. Minor changes that have no adverse effect on the technical adequacy of the job (i.e., on the DQOs) or schedule can be made in the field with approval by the BC Cribs and Trenches Area Task Lead and will be documented in the daily field logbook and/or field summary reports. Changes that affect DQOs will require concurrence by RL and the lead regulatory agency and can be documented through unit managers' meetings. Alternately, if substantial changes are required, this SAP can be revised with RL and regulator approval.

Table 1-4 summarizes the data-collection design for Phase 1 of the treatability test. Only the data-collection designs corresponding to DRs #1 and #2 are applicable to the activities in the 216-B-26 Trench described in this SAP.

Table 1-4. Data-Collection Design.

DR #	Statistical	Nonstatistical	Rationale
1	Adaptive-cluster sampling design	Not applicable	The need to determine the lateral extent will be met using a form of biased sampling aimed at identifying the maximum lateral extent of contamination. The vertical extent of contamination also will be determined in the sampling design selected for addressing DR #2. Therefore, a separate sampling design to resolve vertical extent is not required.
2	Systematic random statistical-sampling design to determine mean concentration of the contaminant of concern.	Not applicable	Determining the mean concentration in a given volume of soil (determined by understanding the vertical and lateral extent of contamination) and knowing the density of the soil allows calculation of the total inventory of the contaminant of concern present in a trench. This measured inventory then can be compared to inventory predicted by the soil-inventory model, and a determination of the soil-inventory model's accuracy can be made. Also, the random sampling design provides information on the variability of contaminants to support dose estimates based on these measurements.

DR = decision rule.

A statistical sampling design is appropriate and required for estimating if the true mean concentration for applicable radionuclide constituents agrees with the concentration predicted by using the inventory inputs for the SIM (DR #2). Adaptive-cluster sampling, which involves the selection of an initial probability-based sample, will be used to determine the lateral extent of contamination. Therefore, while adaptive-cluster sampling is not strictly a statistical sampling method, the method has elements based on a statistical design, because the initial, probability-based sample of units will be the boreholes installed to address DR #2.

Decisions concerning the nature and extent of contamination (DR #1) include determining the vertical and lateral extent of contamination. Contamination for the purposes of this data-collection activity has been defined as soil contaminated with Cs-137 at greater than 750 pCi/g and Sr-90 at greater than 90,000 pCi/g. These values represent maximum concentrations that are protective of human health 150 years from the present under an industrial scenario. This action level only applies to the soil down to 4.6 m (15 ft) below ground surface (bgs), because that depth is the point of compliance for human-health exposure. Further discussion is provided in DOE/RL-2007-15, Appendix A. Samples will be collected to determine if this level of contamination is present. For data collected to determine the lateral extent of contamination, if COCs above the action level are found, additional data collection will be performed to determine the lateral extent of contamination. If the concentrations of the COCs in the additional samples are less than the action level, the extent of contamination can be bounded by the regions from which those samples were collected. If levels of contamination detected in a single measurement are greater than the action levels, the extent of contamination has not been totally resolved by that sample, and additional adaptive-cluster samples must be collected. Another use for the data from measurements conducted on soil samples collected from the boreholes installed to estimate the mean concentration of contaminants in the trench (i.e., from all boreholes except the adaptive-cluster-sampling boreholes) will be to determine if a correlation between Cs-137 and Sr-90 activity can be established as a function of depth.

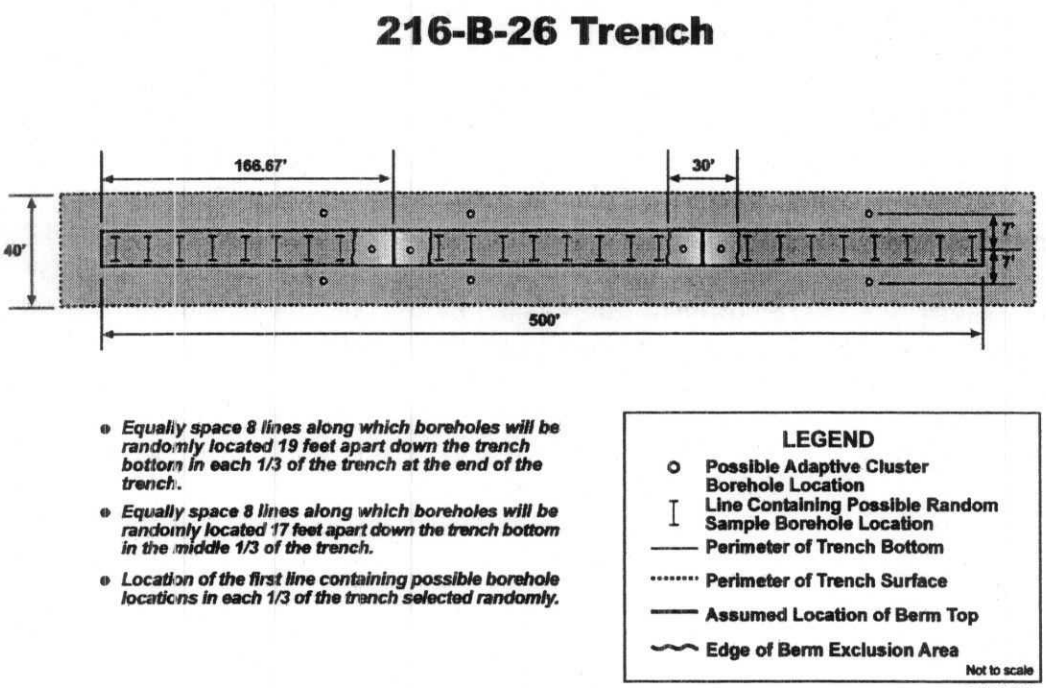
The vertical extent of contamination will be determined by installing all boreholes to 7.6 m (25 ft) bgs. Historical data obtained from boreholes installed down the length of the 216-B-26 Trench show that Cs-137 contamination is less than 750 pCi/g at 6.1 to 6.7 m (20 to 22 ft) bgs in most holes. The data from boreholes where Cs-137 was detected at greater than 750 pCi/g at depths at or below 7.6 m (25 ft) bgs indicate that downhole cross contamination from the significant activity higher up in the borehole may have been occurring. Also, because the action level associated with the industrial-use scenario only is applicable to soils down to a depth of 4.6 m (15 ft) bgs, the DQO team determined that 7.6 m (25 ft) would be a conservative total depth required for the boreholes in determining the vertical extent of contamination.

The lateral extent of contamination will be determined using adaptive-cluster sampling (borehole SGL only; i.e., no soil sampling). Adaptive-cluster sampling involves the selection of an initial probability-based sample. Additional sampling units are selected for observation when a characteristic of interest is present in an initial unit or when the initial unit has a specific value meeting some specified condition (e.g., when a critical threshold is exceeded). Adaptive-cluster-sampling designs have two key elements: (1) choosing an initial sample of units and (2) choosing a rule or condition for determining adjacent units to be added to the sample (EPA/240/R-02/005, *Guidance on Choosing a Sampling Design for Environmental Data Collection*, EPA QA/G-5S). The initial, probability-based sample of units will be the boreholes installed to address DR #2, discussed later in this section.

For the 216-B-26 Trench, the rule or condition that will be used to determine where adjacent units are to be added to the sample will be the relative concentrations measured in at least one borehole from each section of the trench (i.e., each one-third of the 216-B-26 Trench). At least one of the boreholes from each section that shows the highest total Cs-137 inventory will be selected. At points that are 2.1 m (7.0 ft) due north and due south of the centerline of the trench (that is, as measured along a line perpendicular to the center line of the 216-B-26 Trench, which runs due east-west), two additional boreholes will be installed to 7.6 m (25 ft) bgs. If Cs-137 is detected at greater than 750 pCi/g within the first 4.6 m (15 ft) bgs in any of the additional holes, another borehole will be installed 60 cm (2 ft) further (i.e., further north or further south) from the centerline of the trench away from the borehole where the condition was met. This will continue until a borehole is installed that shows no Cs-137 concentrations greater than 750 pCi/g in the 0 to 4.6 m (0 to 15 ft) bgs interval at the 216-B-26 Trench. When the condition of no Cs-137 concentration exceeding the specified action levels is met, no additional boreholes will be installed further from the centerline of the trench in that direction. If the condition of a concentration greater than 750 pCi/g at the 216-B-26 Trench is not met in any of the first adaptive-cluster-sampling boreholes installed 2.1 m (7.0 ft) from the centerline of the trench, additional boreholes may be installed closer to the centerline of the trench along the same line as the first adaptive-cluster borehole until Cs-137 activity is seen to approach 750 pCi/g in the 0 to 4.6 m (0 to15 ft) bgs interval. The BC Cribs and Trenches Area Task Lead will determine how much closer to the benchmark borehole the subsequent adaptive-cluster borehole should be installed when this occurs and whether concentrations measured slightly higher than 750 pCi/g within the first 4.6 m (15 ft) bgs are close enough to define the lateral extent of contamination or if additional boreholes are required.

An estimate of the volume of contaminated soil associated with each one-third section of the trench is required. While the locations of the ends of the trench are known, the locations of the berms are not precisely known. Therefore, the boreholes closest to the berm exclusion area also will be used as benchmark holes for adaptive-cluster sampling (borehole SGL only; i.e., no soil sampling). Additional adaptive-cluster-sampling boreholes will be installed along the center line of the trench 1.2 m (4 ft) away from each borehole closest to the berm in the direction toward the berm, until the condition of a Cs-137 concentration greater than 750 pCi/g in the 0 to 4.6 m (0 to 15 ft) bgs interval is not met. If the condition of a concentration greater than 750 pCi/g at the 216-B-26 Trench is not met in any of the first adaptive-cluster-sampling boreholes installed 1.2 m (4 ft) away from the boreholes closest to the berm along the centerline of the trench toward the berm, additional boreholes will be installed closer to the benchmark boreholes until the concentration is seen to approach 750 pCi/g in the 0 to 4.6 m (0 to15 ft) bgs interval. The BC Cribs and Trenches Area Task Lead will determine how much closer to the benchmark borehole the subsequent adaptive-cluster borehole should be installed when this occurs and whether concentrations measured slightly higher than 750 pCi/g within the first 4.6 m (15 ft) bgs are close enough to define the lateral extent of contamination or if additional boreholes are required. Figure 1-6 shows the adaptive-cluster-sampling design for the 216-B-26 Trench.

Figure 1-6. Random and Adaptive-Cluster-Sampling Design for Trench 216-B-26.



To support decisions associated with DR #2, and to estimate the inventory (and the variability of the concentrations) of radionuclides that will be encountered during partial removal, treatment, and disposal demonstrations at the BC Cribs and Trenches Area waste sites, measurements of the COCs in the 216-B-26 Trench will be used to estimate the mean concentration present. The mean concentration, the volume of soil to which it applies, and the density of the soil can be used to calculate the estimated total inventory present. To aid in performing an estimate of the dose that will be encountered during partial removal, treatment, and disposal operations, an understanding of the variability of radionuclide concentrations in the near-surface soils is required. To estimate a mean with known confidence, a statistical sampling design is required. Systematic random sampling was chosen in this situation to ensure that longitudinal variability along the bottom of the trench is adequately determined. This sampling plan allows the data user to determine how concentrations of contaminants vary along the bottom of the trench by ensuring that no large areas of the trench bottom are left unrepresented in the sample.

To ensure that the sampling design represents the variability of concentrations associated with lateral dispersion of contaminants, the measurements and samples will be collected from boreholes that are installed at selected points along lines that are drawn perpendicular to the centerline of the trench. The perpendicular lines will be drawn at systematic intervals (Figure 1-6). To ensure randomness for the systematic intervals, the location of the first line along which possible borehole locations will be randomly selected also must be selected randomly, and the remaining lines will be drawn equal distances from the first line. The details of the selection of each borehole location are documented in Chapter 3.0. A random-number generator was used to select the distance to the first line drawn perpendicular to the center–line of the trench in each one-third of the trench and to select where on the perpendicular lines the boreholes will be installed.

At each borehole installed in the 216-B-26 Trench, SGL will be performed to provide Cs-137 concentrations for each 15 cm (0.5-ft) interval. This will allow an estimate of the mean concentration of the COCs in each 15 cm (0.5-ft) layer of the soil beneath a trench. In addition, three 15 cm (0.5-ft) intervals will be selected to collect soil samples. It may be necessary to drill a separate DPT borehole nearby for sample collection (i.e., within approximately 30 to 61 cm (1 to 2 ft) of the borehole that is logged. Otherwise, there is potential for the SGL tool to be contaminated. Soil samples collected from boreholes in the 216-B-26 Trench will be sent for laboratory analysis for gamma-emitting radionuclides and Sr-90. The soil-sample analyses will be used to correlate Cs-137 results obtained by SGL to those obtained in a laboratory and to provide Sr-90 concentrations that cannot be measured in the field.

The implementation of the random and adaptive-cluster-sampling design is detailed in Chapter 3.0 of this SAP.

2.0 QUALITY ASSURANCE PROJECT PLAN

The QAPjP establishes the quality requirements for environmental data collection, including sampling, field measurements, and laboratory analysis. The QAPjP complies with the following requirements:

- DOE O 414.1C, *Quality Assurance*
- 10 CFR 830, Subpart A, "Quality Assurance Requirements"
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5.

The following sections describe the quality requirements and controls applicable to this SAP.

2.1 PROJECT MANAGEMENT

This section addresses the basic areas of project management and ensures that the project has a defined goal, that the participants understand the goal and approach to use, and that the planned outputs have been appropriately documented.

2.1.1 Project / Task Organization

Fluor Hanford, or its approved subcontractor, is responsible for collecting, packaging, and shipping samples to the laboratory. Fluor Hanford will select a laboratory to perform the analyses; the selected laboratory must conform to Hanford Site laboratory procedures (or equivalent), as approved by RL and the EPA. Fluor Hanford is responsible for managing all interfaces among subcontractors involved in executing the work described in this SAP. The project organization is described in the subsections that follow and is shown in Figure 2-1.

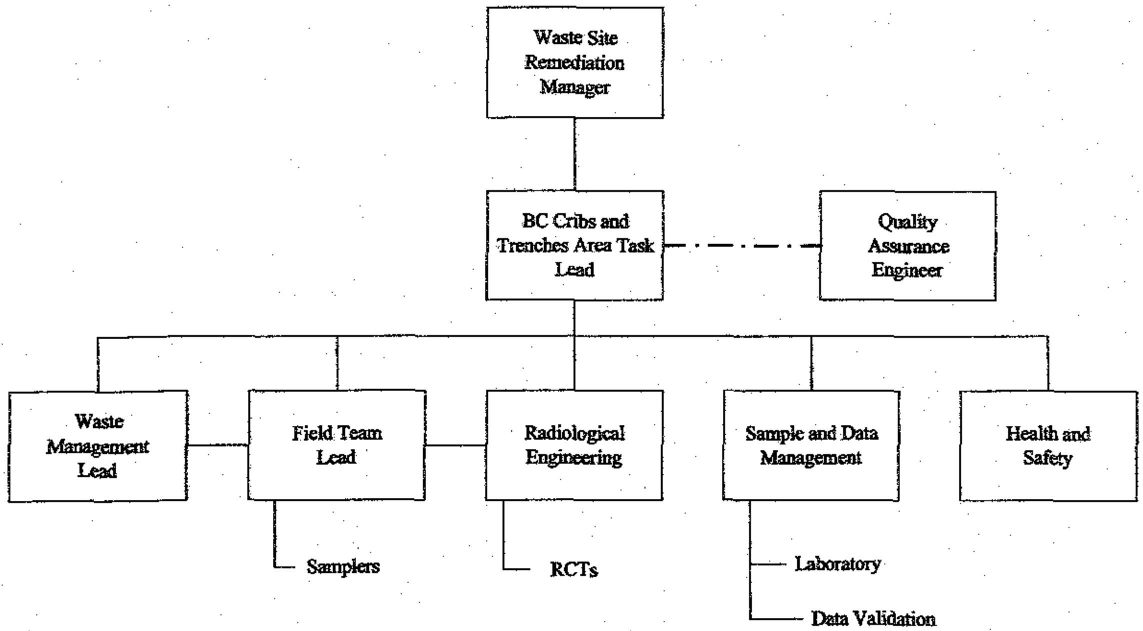
2.1.1.1 Waste Site Remediation Manager

The Waste Site Remediation Manager provides oversight for all activities and coordinates with RL, the regulators, and Fluor Hanford management in support of sampling activities. In addition, the Waste Site Remediation Manager provides support to the Central Plateau Task Lead to ensure that work is performed safely and cost effectively. The Waste Site Remediation Manager maintains the approved QAPjP.

2.1.1.2 BC Cribs and Trenches Area Task Lead

The BC Cribs and Trenches Area Task Lead is responsible for direct management of sampling documents and requirements, field activities, and subcontracted tasks. The BC Cribs and Trenches Area Task Lead ensures that the Field Team Lead, samplers, and others responsible for implementation of the SAP and QAPjP are provided with current copies of this document and any revisions thereto. The BC Cribs and Trenches Area Task Lead works closely with the QA and Health and Safety organizations and the Field Team Lead to integrate these and the other lead disciplines in planning and implementing the scope of work. The BC Cribs and Trenches Area Task Lead coordinates with and reports to RL and Fluor Hanford management on all sampling activities. The BC Cribs and Trenches Area Task Lead supports RL in coordinating sampling activities with the regulators.

Figure 2-1. Project Organization.



2.1.1.3 Quality Assurance Engineer

The QA engineer is matrixed to the BC Cribs and Trenches Area Task Lead and is responsible for QA on the project. Responsibilities include oversight of project QA requirements implementation; review of project documents including DQO summary reports, SAPs, and the QAPjP; and participation in QA assessments on sample collection and analysis activities, as appropriate.

2.1.1.4 Environmental Compliance Officer

The Environmental Compliance Officer is matrixed to the BC Cribs and Trenches Area Task Lead and provides technical oversight, direction, and acceptance of project and subcontracted environmental work and develops appropriate mitigation measures with a goal of minimizing adverse environmental impacts. The Environmental Compliance Officer also reviews plans, procedures, and technical documents to ensure that all environmental requirements have been addressed, identifies environmental issues that affect operations and develops cost-effective solutions, and responds to environmental and regulatory issues or concerns raised by DOE and/or regulatory agency staff.

2.1.1.5 Waste Management Lead

The Waste Management Lead communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner. Other responsibilities include identifying waste management sampling/characterization requirements to ensure regulatory compliance, and interpreting the characterization data to generate waste designations, profiles, and other documents that confirm compliance with waste-acceptance criteria.

2.1.1.6 Field Team Lead

The Field Team Lead has overall responsibility for the planning, coordination, and execution of field characterization activities. Specific responsibilities include converting the sampling-design requirements into field task instructions that provide specific direction for field activities. Responsibilities also include directing training, mock-ups, and practice sessions with field personnel to ensure that the sampling design is understood and can be performed as specified. The f Field Team Lead communicates with the BC Cribs and Trenches Area Task Lead to identify field constraints that could affect the sampling design. In addition, the Field Team Lead directs the procurement and installation of materials and equipment needed to support field work.

The Field Team Lead oversees field sampling activities including sample collection and packaging, provision of certified clean sampling bottles/containers, documentation of sampling activities in controlled logbooks, chain-of-custody documentation, and packaging and transportation of samples to the laboratory or shipping center.

2.1.1.7 Radiological Engineering

The Radiological Engineering organization is responsible for the radiological engineering and health physics support for the project. Specific responsibilities include conducting as-low-as-reasonably-achievable (ALARA) reviews, exposure and release modeling, and radiological controls optimization for all work planning. In addition, radiological hazards are identified and appropriate controls are implemented to maintain worker exposures to hazards at ALARA levels. Radiological Engineering interfaces with the project health and safety representative and plans and directs radiological control technician support for all activities.

2.1.1.8 Sample and Data Management

The Sample and Data Management organization selects the laboratories that perform the analyses. This organization ensures that the laboratories conform to Hanford Site internal laboratory QA requirements (or their equivalent), as approved by RL, the EPA, and the Washington State Department of Ecology. Sample and Data Management receives the analytical data from the laboratories, performs data entry into the *Hanford Environmental Information System* (HEIS) database, and arranges for data validation.

2.1.1.9 Health and Safety

The Health and Safety organization's responsibilities include coordination of industrial safety and health support within the project, as carried out through health and safety plans, job-hazard analyses, and other pertinent safety documents required by Federal regulations or by internal Fluor Hanford work requirements. In addition, assistance is provided to project personnel in complying with applicable health and safety standards and requirements. Personal protective-equipment requirements are coordinated with Radiological Engineering.

2.1.2 Problem Definition / Background

The definition of the problem and background information are provided in Section 1.1 of this SAP.

2.1.3 Project / Task Description

Sampling and analysis activities in the 216-B-26 Trench include installing boreholes in the 216-B-26 Trench, performing SGL measurements of Cs-137 through the boreholes, and collecting soil samples for laboratory analysis for gamma-emitting radionuclides and Sr-90. The soil-sample analyses will be used to correlate Cs-137 results obtained by SGL to those obtained in a laboratory and to provide Sr-90 concentrations that cannot be measured in the field. The sampling and analysis activities are described in further detail in Chapter 3.0 of this SAP. The data resulting from this SAP ultimately will be reported in a treatability test report and will support the feasibility study.

2.1.4 Quality Objectives and Criteria

The QA objective of this plan is to develop implementation guidance that will provide data of known and appropriate quality. Data quality is assessed by accuracy and precision, by evaluation against the identified DQOs, and by evaluation against the work activities identified in this SAP. The applicable QC guidelines, quantitative target limits, and levels of effort for assessing data quality are dictated by the intended use of the data and the nature of the analytical method, which are addressed in the following subsections.

2.1.4.1 Accuracy

Accuracy is an assessment of the closeness of the measured value to the true value. Accuracy of chemical test results may be assessed by spiking samples with known standards and establishing the average recovery. A matrix spike is the addition to a sample of a known amount of a standard compound similar to the compounds being measured. Radionuclide measurements that require chemical separations use this technique to measure method performance. For radionuclide measurements that are analyzed by gamma spectroscopy, laboratories typically compare the results of blind audit samples against known standards to establish accuracy. Validity of calibrations is evaluated by comparing results from the measurement of a standard to known values and/or by generating in-house statistical limits based on three standard deviations (i.e., 3 SD).

2.1.4.2 Precision

Precision is a measure of the data spread when more than one measurement has been taken on the same sample. Precision can be expressed as the relative percent difference for duplicate measurements or relative standard deviation for replicate analyses.

2.1.4.3 Detection Limits

Detection limits are functions of the analytical method used to provide the data and the quantity of the sample available for analyses.

Quality objectives and criteria (including analytical methods, detection limits, and precision and accuracy requirements for each analysis to be performed) are summarized in Table 2-1 for field measurements and Table 2-2 for laboratory analyses.

2.1.5 Special Training Certification

Training or certification requirements have been instituted by the Fluor Hanford team to meet the training requirements imposed by the Fluor Hanford contract, regulations, DOE orders, contractor requirements documents, American National Standards Institute/American Society of Mechanical Engineers standards, the *Washington Administrative Code*, etc.

The Environmental Health and Safety Training Program provides workers with the knowledge and skills necessary to safely execute assigned duties. Field personnel typically will have completed the following training before starting work:

- Occupational Safety and Health Administration 40-Hour Hazardous Waste Worker Training
- 8-Hour Hazardous Waste Worker Refresher Training (as required)
- Radiological Worker Training
- Hanford General Employee Training.

A graded approach is used to ensure that workers receive a level of training that is commensurate with their responsibilities and that complies with applicable DOE orders and government regulations. Specialized employee training includes pre-job briefings, on-the-job training, emergency preparedness, plan-of-the-day activities, and facility/worksite orientations. Field personnel training records will be documented and kept on file by the training organization.

Table 2-1. Analytical Performance Requirements for Radiological Field Measurements.

Contaminant of Concern	Chemical Abstracts Service	Preliminary Action Level		Name/Analytical Technology	Target Required Quantitation Limits		Precision Water (%)	Accuracy Water (%)	Precision Soil (%)	Accuracy Soil (%)
		15 mrem/yr [a] (pCi/g)	ERDF Waste-Acceptance Criteria		Water [b] Conc. (pCi/L or mg/L)	Soil-Other Conc. (pCi/g)				
Cs-137	10045-97-3	750 [a]	N/A	HPGe – SGL [c] NaI – SGL [c]	N/A	300	N/A	N/A	±20	80-120

[a] The preliminary action levels for radionuclides using the 15 mrem/yr = non-rad worker industrial exposure scenario; 2,000 h/yr onsite, 60 percent indoors, 40 percent outdoors are based on the need to determine vertical and lateral extent of contamination. The action levels have been decay corrected, based on the assumption that institutional controls will be in place for 150 years.

[b] Environmental Restoration Disposal Facility waste-acceptance criteria.

[c] HPGe detectors for SGL require a minimum 4-in.-diameter borehole. NaI detectors require a minimum 2-in.-diameter borehole.

ERDF = Environmental Restoration Disposal Facility.
HPGe = high-purity germanium (spectral gamma logger).
N/A = not applicable.
NaI = sodium iodide.
SGL = spectral-gamma borehole logging.

Table 2-2. Analytical Performance Requirements for Radiological Laboratory Measurements.

Contaminant of Concern	Chemical Abstracts Service	Preliminary Action Level [a]		Name/Analytical Technology	Target Required Quantitation Limits			Precision Water (%)	Accuracy Water (%)	Precision Soil (%)	Accuracy Soil (%)
		15 mrem/yr (pCi/g)	Ground-water Protection (pCi/g or mg/kg)		Water [b] Conc. (pCi/L)	Soil Low Activity [c] (pCi/g)	Soil High Activity [d] (pCi/g)				
Cs-137 [e]	10045-97-3	23.4	N/A	GEA	N/A	0.1	2,000	N/A	N/A	±35	65-135
Sr-90	Rad-Sr	2,410	N/A	Total radioactive strontium – GPC or LSC	N/A	1	800	N/A	N/A	±35	65-135

[a] The preliminary action levels for radionuclides are based on 15 mrem/yr = non-rad worker industrial exposure scenario; 2,000 h/yr onsite, 60 percent indoors, 40 percent outdoors and are used to determine appropriate analytical requirements.

[b] Water values for sampling quality control (e.g., equipment blanks/rinses) or drainable liquid (if recovered).

[c] Low activity implies a level of radioactivity such that the radioanalytical methods can be performed as designed. The quantitation limits are the state of the art for a soil-sample matrix using the given technology.

[d] High activity implies a level of radioactivity such that the radioanalytical methods cannot be performed as designed. Some method deviation (e.g., use of a smaller aliquot of soil) must be selected to ensure the health and safety of sampling and/or laboratory personnel. The quantitation limits listed are estimated and provided as an illustration of the variability in the possible quantitation limits that result from high radioactivity in the soil samples collected.

[e] Cs-137 is the only gamma-emitting radionuclide with an action level. However, other detected gamma-emitting radionuclides will be reported during analyses conducted by gamma energy analysis.

GEA = gamma-energy analysis.
GPC = gas-proportional counting.
N/A = not applicable.
LSC = liquid-scintillation counter.

2.1.6 Documentation and Records

The BC Cribs and Trenches Area Task Lead ensures that the Field Team Lead, samplers, and others responsible for implementation of this SAP and QAPjP are provided with current copies of this document and any revisions thereto.

Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes that comprise a collection of document-control systems and processes that use a graded approach for the preparation, review, approval, distribution, use, revision, storage/retention, retrieval, disposition, and protection of documents and records generated or received in support of Fluor Hanford work.

All information pertinent to field sampling and analysis will be recorded in bound logbooks or appropriate forms or media as directed by procedure. The sampling team will be responsible for recording all relevant sampling information in the logbooks. Entries made in the logbook will be dated and signed by the individual making the entry.

Data collected through sampling will support the development and evaluation of remedial alternatives through the feasibility-study process. This evaluation will be documented and summarized in the proposed plan. These documents will be prepared in accordance with CERCLA requirements and guidance and with the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al., 1989). In addition to these formal documents, a contractor-level document will be produced to summarize the field activities and to capture (in a referenceable form) the SGL data collected from the installing activities. The borehole summary report will be consistent with similar documents prepared for the other boreholes.

Primary documents under the Tri-Party Agreement will be submitted to the Administrative Record. All other documentation will be prepared, approved and maintained in accordance with RL and contractor requirements for these processes.

2.2 DATA GENERATION AND ACQUISITION

This section presents the requirements for sampling methods, sample handling and custody, analytical methods, and field and laboratory QC. The requirements for instrument calibration and maintenance, supply inspections, and data management also are discussed.

2.2.1 Sampling-Process Design

The borehole locations will be staked before the field engineer begins installing them. Minor changes in sample locations can be made and documented in the field. More significant changes in sample locations that do not impact the DQOs will require notification and approval of the BC Cribs and Trenches Area Task Lead. Changes to sample locations that could result in impacts to meeting the DQOs will require RL and lead regulatory agency concurrence. The field team will note in the daily field-sampling logbook any instance when samples cannot be collected because of field conditions. These events will be discussed in the follow-up borehole summary report. Sample locations may be adjusted, based on visual or field-screening methods that may indicate a better sampling location to meet the DQOs (e.g., higher concentrations at a different depth). Additional locations may be sampled based on the judgment of field personnel and the BC Cribs and Trenches Area Task Lead, based on real-time field conditions. Additional specifications regarding sample locations are found in Chapter 3.0 of this SAP.

2.2.2 Sampling Methods

The borehole sampling associated with this SAP will be performed in accordance with established sampling practices and requirements pertaining to sample collection, collection equipment, and sample handling. These practices include (1) steps to preclude cross contamination of the sample by using disposable precleaned sampling equipment and (2) the cleaning or decontamination of reusable sampling equipment, in accordance with internal procedures that are consistent with EPA cleaning protocols. The Field Team Lead and the BC Cribs and Trenches Area Task Lead are responsible for ensuring that all field procedures are followed completely and that field personnel are trained adequately. The Field Team Lead and the BC Cribs and Trenches Area Task Lead must document situations that may impair the usability of the samples and/or data in the field logbook or on nonconformance report forms, in accordance with internal corrective-action procedures, as appropriate. The Field Team Lead will note any deviations from the standard procedures for sample collection, COCs, sample transport, or monitoring that occurs. The Field Team Lead also will be responsible for coordinating all activities relating to the use of field monitoring equipment (e.g., dosimeters, industrial-hygiene equipment). Field personnel will document in the logbook all noncompliant measurements taken during field sampling. Ultimately, the BC Cribs and Trenches Area Task Lead will be responsible for corrective action when a failure occurs in the sampling or measurement system, for documenting all deviations from procedure, and for ensuring that immediate corrective actions are applied to field activities. Problems with sample collection, custody or data acquisition that adversely impact the quality of data or impair the ability to acquire data, or failure to follow procedure, will be documented in accordance with internal corrective-action procedures, as appropriate.

2.2.3 Sample Handling, Shipping, and Custody Requirements

Level I EPA precleaned sample containers will be used for samples collected for radiological analysis. Container sizes may vary, depending on laboratory-specific volumes/requirements for meeting analytical detection limits. If, however, the dose rate on the outside of a sample jar or the curie content exceeds levels acceptable by the laboratory, the sampling lead and BC Cribs and Trenches Area Task Lead can send smaller volumes to the laboratory after consultation with Fluor Hanford Sample and Data Management to determine acceptable volumes. Sample preservation, container, holding time requirements are provided in Table 2-3. Final sample collection requirements will be identified on the Sampling Authorization Form.

Table 2-3. Sample Preservation, Container, and Holding Time Guidelines for Radionuclides.

Analytes	Matrix	Bottle		Amount [a]	Preservation	Packing Requirements	Holding Time
		Number	Type				
Cesium-137	Soil	1	G/P	100-1500 g	None	None	6 months
Strontium-90	Soil	1	G/P	10-1000 g	None	None	6 months

[a] Optimal volumes, which may be adjusted downward to accommodate the possibility of retrieval of a small amount of sample. Minimum sample size will be defined in the Chain-of-Custody form.
G/P = glass or plastic.

The Fluor Hanford *Sample Data Tracking* database will be used to track the samples from the point of collection through the laboratory analysis process. The HEIS database is the repository for laboratory analytical results. The HEIS sample numbers will be issued to the sampling organization for this project in accordance with onsite organization procedures. The HEIS sample numbers will be issued to the sampling organization for this project in accordance with onsite organization procedures. Each radiological sample will be identified and labeled with a unique HEIS sample number. The sample location, depth, and corresponding HEIS numbers will be documented in the sampler's field logbook.

Each sample container will be labeled with the following information using a waterproof marker on firmly affixed, water-resistant labels:

- Sampling Authorization Form
- HEIS number
- Sample collection date/time
- Name of person collecting the sample
- Analysis required
- Preservation method (if applicable).

A custody seal (i.e., evidence tape) will be affixed to the lid of each sample jar in a manner that will indicate potential tampering with the sample. The container seal will be inscribed with the sampler's initials and the date.

2.2.4 Laboratory Sample Custody

Sample custody during laboratory analysis will be addressed in the applicable laboratory standard operating procedures. Laboratory custody procedures will ensure the maintenance of sample integrity and identification throughout the analytical process.

Sample custody will be maintained in accordance with existing Hanford Site protocols. The custody of samples will be maintained from the time that the samples are collected until the ultimate disposal of the samples, as appropriate. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory. Wire or laminated waterproof tape will be used to seal the coolers. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Chain-of-custody procedures will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. Each time the responsibility changes for the custody of the sample, the new and previous custodians will sign the record and note the date and time. The sampler will make a copy of the signed record before the sample is shipped and will transmit the copy to Fluor Hanford Sample and Data Management within 48 hours of shipping.

The radiological control technician will measure both the contamination levels on the outside of each sample jar and the dose rates on each sample jar. The radiological control technician also will measure the radiological activity on the outside of the sample container (through the container) and will document the highest contact radiological reading in millirem per hour. This information, along with other data, will be used to select proper packaging, marking, labeling and shipping paperwork in accordance with U.S. Department of Transportation regulations (49 CFR, "Transportation") and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory's acceptance criteria. The sampler will send copies of the shipping documentation to Fluor Hanford Sample and Data Management within 48 hours of shipping.

2.2.5 Analytical Methods

Requirements for detection limits, precision, and accuracy are presented in Table 2-1 for radiological field measurements and Table 2-2 for radiological laboratory measurements. The analytical technologies also are shown in these tables. These analytical methods are controlled in accordance with the laboratory's QA plan and the requirements of this SAP.

Laboratories providing analytical services in support of this SAP will be responsible for establishing a corrective-action program that addresses the following:

- Evaluation of impacts of laboratory QC failures on data quality
- Root-cause analysis of QC failures
- Evaluation of recurring conditions that are adverse to quality
- Trend analysis of quality-affecting problems
- Implementation of a quality-improvement process
- Control of nonconforming materials that may affect data quality.

Implementation of these corrective-action processes will be evaluated as part of periodic laboratory audits by Hanford Site contractors or by DOE.

Communications with the laboratory will be managed by the Fluor Hanford Sample and Data Management organization. Sample and Data Management will be responsible for communicating the status, issues, corrective actions, and other pertinent laboratory information to the BC Cribs and Trenches Area Task Lead and the Waste Site Remediation Manager. Errors reported by the laboratories are reported to the Sample Management Project Coordinator, who initiates a Sample Disposition Record. This process is used to document analytical errors and to establish resolution with the BC Cribs and Trenches Area Task Lead.

2.2.6 Quality Control Requirements

The QC procedures must be followed in the field and laboratory to ensure that reliable data are obtained. When field sampling is performed, care should be taken to prevent the cross-contamination of sampling equipment, sample bottles, and other equipment that could compromise sample integrity.

Field QC samples will be collected to evaluate the potential for cross-contamination and laboratory performance. The QC samples and the required frequency for collection are described in this section. The QC samples will be collected as part of the verification and confirmatory sampling activities.

The collection of QC samples for onsite measurements is not applicable to the SGL measurements described in this SAP. Field instrumentation will be calibrated and controlled as discussed in Sections 2.2.7 and 2.2.8, as applicable.

The laboratory method blank, laboratory-control sample/blank spike, and matrix spike are defined in Chapter 1 of SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-B*, as amended, and will be run at the frequency specified in that reference.

2.2.6.1 Field Duplicates

Field duplicates are independent samples collected as close as possible to the same point in space and time, taken from the same source, stored in separate containers, and analyzed independently. These samples are not to be homogenized together. Field duplicates provide information regarding the variability of the measurement system attributable to the sample collection procedures, the sample matrix, and the precision of the analysis process.

Because previous characterization data show that the soil in the 216-B-26 Trench is quite inhomogeneous, an anticipated high degree of variability was taken into account in the sampling design. A sufficient number of samples will be collected to establish the variability of the sample. Therefore, no data use is associated with colocated field duplicates, and none of these samples will be collected. For the BC Cribs and Trenches Area waste site treatability test, information to aid in the assessment of laboratory precision will be generated by having the analytical laboratory conduct analyses of two aliquots from a collected soil sample. A minimum of 5 percent of the total collected soil samples will be analyzed in duplicate (i.e., test one sample for every 20 samples).

2.2.6.2 Equipment Rinsate Blanks

Equipment blanks typically are collected at the same frequency that the duplicate samples are collected and are used to verify the adequacy of sampling equipment decontamination procedures. Because the action levels associated with this treatability test are relatively high, the impact to decisions is not as great as in trace-level analyses. Adequacy of equipment cleaning will be demonstrated by smears and surveys similar to those conducted by radiological control technicians for removal of equipment from contamination zones.

2.2.6.3 Field Transfer Blanks

Field transfer blanks (i.e., trip blanks) are not required, because no sampling for volatile organic analyses is planned.

2.2.7 Instrument / Equipment Testing, Inspection, and Maintenance

All onsite environmental instruments will be tested, inspected, and maintained in accordance with the manufacturers' operating instructions and in accordance with approved work packages. Results from testing, inspection, and maintenance activities are documented in logbooks and/or work packages.

Analytical laboratory instruments and measuring equipment are tested, inspected, and maintained in accordance with the laboratories' QA plans. Daily response checks for radiological-field survey instruments are performed in accordance with approved work packages.

Measurement and testing equipment used in the field or in the laboratory that directly affect the quality of analytical data will be subject to preventive maintenance measures to minimize the downtime of the measurement system. Laboratories and onsite measurement organizations must maintain and calibrate their equipment. Maintenance requirements (e.g., parts lists and documentation of routine maintenance) will be included in the individual laboratories and the onsite organization's QA plans or operating procedures (as appropriate). Calibration of laboratory instruments will be performed in a manner consistent with SW-846 or with auditable DOE Hanford Site-wide and contractual requirements. The calibration of radiological field instruments is discussed in Section 2.2.8.

Consumables, supplies, and reagents will be reviewed in accordance with SW-846 requirements and will be appropriate for their use. Note that contamination is monitored using the QC sample process discussed in Section 2.2.

2.2.8 Instrument / Equipment Calibration and Frequency

All onsite environmental instruments are calibrated in accordance with the manufacturers' operating instructions, internal work requirements and processes, and/or work packages that provide direction for equipment calibration or verification of accuracy by analytical methods. The results from all instrument-calibration activities are recorded in logbooks and/or work packages.

Equipment expected to be used includes a sodium-iodide (NaI) detector SGL system (for small-diameter boreholes) and various portable radiation-control monitoring equipment. The borehole SGL equipment is calibrated (at least) annually on the Hanford Site calibration models located near the weather station. Portable radiation-control monitoring equipment is calibrated by the Pacific Northwest National Laboratory.

Analytical-laboratory instruments and measuring equipment are calibrated in accordance with the laboratories' QA plans. Calibration of radiological-field survey instruments on the Hanford Site is performed under contract by Pacific Northwest National Laboratory on an annual basis, as specified in their program documentation. Field instrumentation, calibration, and QA checks will be performed in accordance with the following.

- Calibration of radiological field instruments on the Hanford Site is performed under contract by Pacific Northwest National Laboratory, as specified in Pacific Northwest National Laboratory program documentation.

- Daily calibration checks will be performed and documented for each instrument used to characterize areas that are under investigation. These checks will be made on standard materials that are sufficiently similar to the matrix under consideration, that direct comparison of data can be made. Analysis times will be sufficient to establish detection efficiency and resolution.

2.2.9 Inspection / Acceptance of Supplies and Consumables

Supplies and consumables that Fluor Hanford procures to use in support of sampling and analysis activities are procured in accordance with internal work requirements and processes. These requirements and processes describe the Fluor Hanford acquisition system and the responsibilities and interfaces necessary to ensure that structures, systems, and components, or other items and services procured/acquired for Fluor Hanford, meet the specific technical and quality requirements. The procurement process ensures that purchased items and services comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users before use.

Supplies and consumables procured by the analytical laboratories are procured, checked, and used in accordance with the laboratories' QA plans.

2.2.10 Nondirect Measurements

Nondirect measurements include data obtained from sources such as computer databases, programs, literature files, and historical databases. Nondirect measurements will not be evaluated as part of this activity.

2.2.11 Data Management

Data resulting from the implementation of this SAP will be managed and stored in accordance with applicable programmatic requirements governing data-management procedures. At the direction of the BC Cribs and Trenches Area Task Lead, all analytical data packages will be subject to final technical review by personnel assigned by the project, before the results are submitted to the regulatory agencies or included in reports. Electronic data access, when appropriate, will be via a database (e.g., HEIS or a project-specific database). Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the Tri-Party Agreement (Ecology et al., 1989, as amended).

Planning for sample collection and analysis will be in accordance with the programmatic requirements governing fixed-laboratory sample-collection activities, as discussed in the sampling teams' procedures. In the event that specific procedures do not exist for a particular work evolution, or if additional guidance is needed to complete certain tasks, an appropriate work package will be developed to adequately control the activities. Examples of the sample teams' requirements include activities associated with the following:

- Chain-of-custody/sample analysis requests
- Project and sample identification for sampling services
- Control of certificates of analysis
- Logbooks and checklists
- Sample packaging and shipping.

Approved work control packages and procedures will be used to document radiological measurements when this SAP is being implemented. Examples of the types of documentation for field radiological data include the following:

- Instructions regarding the minimum requirements for documenting radiological controls information in accordance with 10 CFR 835, "Occupational Radiation Protection"

- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of Hanford Site radiological records

- The minimum standards and practices necessary for preparing, performing, and retaining radiological-related records

- Indoctrination of personnel on the development and implementation of survey/sample plans

- The requirements associated with preparing and transporting regulated material.

Data will be cross-referenced between laboratory analytical data and radiation measurements to facilitate interpretation of the investigation results. Errors reported by the laboratories are reported to the Sample Management Project Coordinator, who initiates a Sample Disposition Record. This process is used to document analytical errors and to establish resolution with the BC Cribs and Trenches Area Task Lead.

2.3 ASSESSMENT / OVERSIGHT

Assessment and oversight activities evaluate the effectiveness of project implementation and associated QA and QC activities. The purpose of assessment is to ensure that the QAPjP is implemented as prescribed.

2.3.1 Assessments and Response Action

The Fluor Hanford QA group may conduct random surveillances and assessments to verify compliance with the requirements outlined in this SAP, project work packages, the project quality management plan, procedures, and regulatory requirements.

Deficiencies identified during these assessments will be reported in accordance with existing programmatic requirements. The QA group coordinates the reporting of deficiencies in accordance with Fluor Hanford's QA program. When appropriate, corrective actions will be taken by the project engineer and/or BC Cribs and Trenches Area Task Lead.

Oversight activities in the analytical laboratories, including corrective-action management, are conducted in accordance with the laboratories' QA plans. Fluor Hanford conducts oversight of offsite analytical laboratories to qualify them for performing Hanford Site analytical work. No assessments have been planned specifically for this task.

2.3.2 Reports to Management

Reports to management on data quality issues will be made if and when these issues are identified. These issues will be reported by laboratory personnel to the Sample Management group, which then will communicate the issues to the BC Cribs and Trenches Area Task Lead and manager. Subsequently, standard reporting protocols (e.g., project status reports) will be used to communicate these issues to management. Because performance or system assessments are not planned as part of this activity, the BC Cribs and Trenches Area Task Lead will not be providing audit or assessment reports to management for this activity, unless an unanticipated request is made to conduct such an assessment. At the end of the project, a data-quality assessment report will be prepared to evaluate whether the type, quality, and quantity of collected data meet the intent of the DQOs and SAP.

2.4 DATA VALIDATION AND USABILITY

Data validation and usability activities occur after the data-collection phase of the project is completed. Implementation of these elements determines whether the data conform to the specified criteria and therefore satisfy project objectives.

2.4.1 Data Review, Verification, and Validation

The criteria for verification include, but are not limited to, review for completeness (all samples were analyzed as requested), use of the correct analytical method/procedure, identification of transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Laboratory personnel may perform data verification.

Data validation will be performed to ensure that the data quality goals established during the planning phase have been achieved. As recommended in EPA guidance (Bleyler, 1988a, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*; Bleyler, 1988b, *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses*), the criteria for data validation are based on a graded approach. The primary contractor has defined five levels of validation, A through E. Level A is the lowest level and is the same as verification. Level E is a 100 percent review of all data (e.g., calibration data, calculations of representative samples from the dataset).

Validation will be performed to contractor Level C. Level C validation is a review of the QC data and specifically requires verifying deliverables and requested-versus-reported analyses and qualifying the results based on analytical holding times, and verifying method blank results, matrix spikes/matrix spike duplicates, surrogate recoveries, duplicates, and analytical method blanks. Level C validation will be performed on at least 5 percent of the data by matrix and analyte group. Analyte group refers to categories such as radionuclides, volatile chemicals, semivolatiles, polychlorinated biphenyls, metals, and anions. The goal is to cover the various analyte groups and matrices during the validation.

Relative to analytical data in sample media, physical data and/or field screening results are of lesser importance in making inferences of risk. Because of the secondary importance of such data, no validation for SGL results will be performed. However, field QA/QC will be reviewed to ensure that the data are useable.

2.4.2 Verification and Validation Methods

Validation activities will be based on EPA functional guidelines (Bleyler 1988a, Bleyler 1988b). Data validation may be performed by the analytical laboratory, by Sample and Data Management, and/or by a party independent of both the data collector and the data user.

When outliers or questionable results are identified, additional data validation will be performed. The additional validation will be performed for up to 5 percent of the statistical outliers and/or questionable data. The additional validation will begin with Level C and may increase to Levels D and E as needed to ensure that the data are usable. Note that Level C validation is a review of the QC data, while Levels D and E include review of calibration data and calculations of representative samples from the dataset. All data validation will be documented in data-validation reports. An example of questionable data is positive detections greater than the practical quantitation limit or reporting limit in soil, from a reference site that should not have exhibited contamination. Similarly, results below background would not be expected and could trigger a validation inquiry. The determination of data usability will be conducted and documented in the data-quality assessment.

All data validation will be documented in data-validation reports that will be provided to the Sampling Coordinator. The Sampling Coordinator is responsible for distributing the data validation report as necessary.

2.4.3 Reconciliation with User Requirements

The data will be reviewed to determine whether the data quality objectives were met with regard to precision, accuracy, and completeness. Conclusions will be drawn as to whether the data are of sufficient quality and quantity to estimate the amount of material requiring removal (i.e., define the lateral and vertical extent of the excavations), to calculate a predicted dose that remediation workers will receive in Phase 2 of the treatability test, and to correlate the total curie content of Cs-137 in the trench as determined by measurements and estimates of contaminated volume with the total curie content predicted by RPP-26744.

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3.0 FIELD SAMPLING PLAN

3.1 SAMPLING OBJECTIVES

This field sampling plan is based on the sampling design developed during the DQO process (DOE/RL-2007-15, Appendix A) and describes the pertinent elements of the sampling program. Sample methods, procedures, locations, and frequencies for the data collection associated with the treatability test are identified in this section.

The field-sampling objectives include the following:

- Determine the vertical and lateral extent of Cs-137 and Sr-90 near-surface contamination in the 216-B-26 Trench.

3.2 PHASE 1: TRENCH 216-B-26 CHARACTERIZATION

Phase 1 of the treatability test involves characterization of the 216-B-26 Trench with small-diameter boreholes installed to a depth of 7.6 m (25 ft) using a DPT technique. Data to characterize the Cs-137 concentration as a function of depth will be collected using SGL instruments. An SGL instrument equipped with an NaI detector will be inserted in the casing of each borehole, and measurements will be made at 15 cm (0.5-ft) intervals. Measurements will be converted to Cs-137 concentration. The concentration reported represents the average soil concentration associated with the soils considered to be within the region of influence on the instrument's detector. The personnel performing the SGL measurements and SGL data reduction and reporting functions have significant experience with making these measurements at Hanford Site waste sites. To provide some confirmation of the Cs-137 measurements made by the SGL instrument, and to provide a means for determining Sr-90 concentration as a function of depth, soil samples will be collected from three depths in each of the boreholes, at approximately 3.7, 4.6, and 5.2 m (12, 15 and 17 ft) bgs. It may be necessary to drill a separate DPT borehole nearby for sample collection (i.e., within approximately 30 to 61 cm (1 to 2 ft) of the borehole that is logged. Otherwise, there is a potential for the SGL tool to be contaminated. The same three depths will be used for soil-sample collection in each borehole to provide a measure of the continuous nature of Sr-90 concentrations at these depths. The soil samples will be sent for laboratory analysis for gamma-emitting radionuclides and total strontium.

It is known that the length of the 216-B-26 Trench was divided into thirds by berms. Therefore, it is possible that different amounts of waste were received in each one-third of the trench. Because of this, a mean inventory of Cs-137 will be estimated using the mean concentration (and assumed volume of contaminated soil) determined for each one-third of the trench.

Eight boreholes will be installed through the bottom of each one-third of the trench. Systematic random sampling was chosen to ensure that a large portion of the trench floor would not go unrepresented by the sample collected. To ensure that any variability associated with lateral distance from the centerline of the trench bottom is adequately characterized by the sample, a random component also is added to the sampling design in these directions. The systematic component of the random sampling design requires that the line along which the first borehole will be located in each one-third section of the trench be selected randomly, and the subsequent boreholes are randomly located on additional lines that are equal distances apart (Figure 3-1). The variance associated with lateral distance from the centerline will be included in the sample by using a line perpendicular to the centerline of the trench. Each of these lines (hereinafter referred to as node lines) will have nine nodes at which a borehole may be installed. The nodes on each node line will be 30 cm (1 ft) apart, with one node on the centerline and four others on each side of the line (Figure 3-2). The boreholes will be installed at locations defined by (1) specifying the distance from survey markers placed on the surface above the centerline of the trench that the node lines are drawn to and (2) installing the borehole at one of the randomly selected nodes.

Figure 3-1. Random and Adaptive-Cluster-Sampling Design for Trench 216-B-26, Showing Placement of Survey Markers.

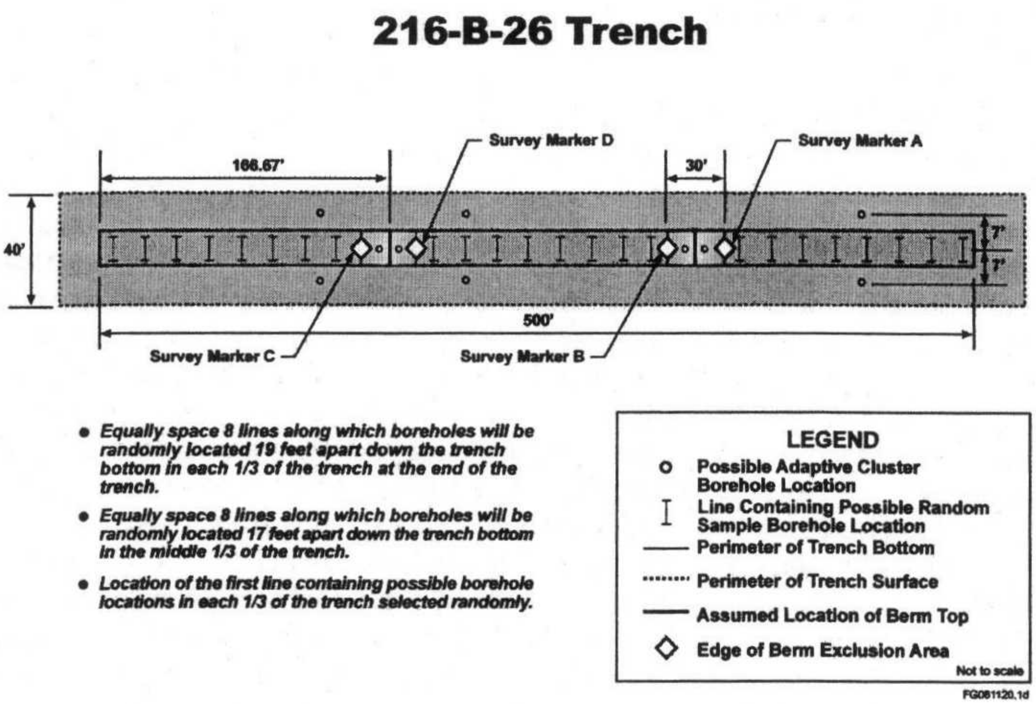
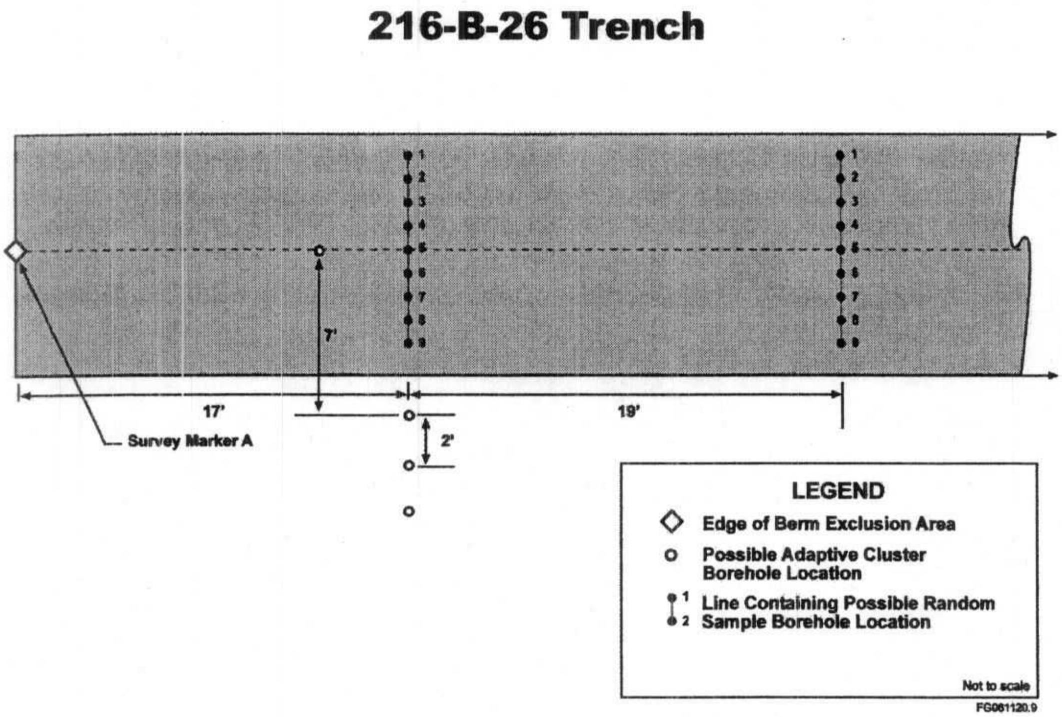


Figure 3-2. First Two Sample Node Lines and the Randomly Selected Nodes for Locating Boreholes in the Eastern One-Third of the 216-B-26 Trench.



Survey stakes (or alternative suitable markers) marking the centerline of the trench will be placed on the present ground-surface end of the trench and at a distance of 50.8 m (166.7 ft) from each end. The markers at 50.8 m (167 ft) will be assumed to locate the top of the berms. To eliminate the possibility of intersecting the berms, an exclusion area 9.1 m (30 ft) wide will be delineated around each berm, in which no boreholes will be installed. Survey markers (A, B, C, and D) will be placed at points along the centerline of the trench 4.5 m (15 ft) on either side of the markers that will indicate the assumed locations of the berm edges (Figure 3-1). Three of the four markers that delineate the exclusion zone (survey markers A, B, and C) will be used as benchmark locations from which the systematic random-sampling design will originate.
A random number generator was used to select the distance to the first node line that is drawn perpendicular to the centerline of the trench in each one-third of the trench and to select the node along the perpendicular line through which the borehole will be installed. Each subsequent borehole will be installed at a randomly selected node that lies on the equally-spaced node lines. That is, all of the node lines will be equal distances from the preceding line. The systematic random sampling design will begin using survey marker A (Figure 3-1) as a benchmark, and node lines perpendicular to the center line of the trench will be drawn at 5.2, 11.0, 16.8, 22.6, 28.4, 34.1, 39.9, and 45.7 m (17, 36.0, 55.0, 74.0, 93.0, 112, 131, and 150 ft) away from survey marker A toward the east end of the trench. The boreholes will be installed at the nodes indicated in Table 3-1.

Table 3-1. Borehole Locations in the 216-B-26 Trench.

Borehole Locations in the Eastern One-Third of the 216-B-26 Trench			
Distance of Node Line from Survey Marker A (ft)	**Sample Node**	**Distance From Centerline Node 5 (ft)**	**Direction From Centerline Node 5**
17.0	8	3	South
36.0	4	1	North
55.0	2	3	North
74.0	2	3	North
93.0	9	4	South
112	5	0	N/A
131	7	2	South
150	8	3	South
Borehole Locations in the Center One-Third of the 216-B-26 Trench			
Distance of Node Line from Survey Marker B (ft)	**Sample Node**	**Distance From Centerline Node 5 (ft)**	**Direction From Centerline Node 5**
15.0	3	2	North
32.0	5	0	N/A
49.0	3	2	North
66.0	6	1	South
83.0	5	0	N/A
100	2	3	North
117	2	3	North
134	6	1	South
Borehole Locations in the Western One-Third of the 216-B-26 Trench			
Distance of Node Line from Survey Marker C (ft)	**Sample Node**	**Distance From Centerline Node 5 (ft)**	**Direction From Centerline Node 5**
13.0	8	3	South
32.0	6	1	South
51.0	4	1	North
70.0	8	3	South
89.0	7	2	South
108	2	3	North
127	5	0	N/A
146	1	4	North

N/A = not applicable.

After the sampling and SGL measurements in these boreholes have been completed, borehole locations in the center section of the trench will be defined using survey marker B as the origin benchmark. Boreholes will be installed along node lines drawn perpendicular to the centerline of the trench at points 4.6, 9.8, 14.9, 20.1, 25.3, 30.5, 35.7, and 40.8 m (15, 32, 49.0, 66.0, 83.0, 100, 117, and 134 ft) away from survey marker B toward the west end of the trench (toward survey marker D). The boreholes will be installed at the nodes indicated in Table 3-1. The final set of boreholes node lines drawn perpendicular to the centerline of the trench will originate using survey marker C as the benchmark. The boreholes will be installed along node lines drawn perpendicular to the centerline of the trench at points 4.0, 9.8, 15.5, 21.3, 27.1, 32.9, 38.7, and 44.5 m (13, 32, 51.0, 70.0, 89.0, 108, 127, and 146 ft) away from survey marker C toward the west end of the trench. The boreholes will be installed at the nodes indicated in Table 3-1. Figure 3-2 depicts a scale drawing of the trench floor showing the first two sample node lines and the randomly selected nodes for locating boreholes in the eastern one-third of the 216-B-26 Trench.

When the data from all boreholes installed through the bottom of the trench have been reviewed, at least one node 5 (i.e., the node at the centerline of the trench) from each one-third of the trench will be used as a benchmark for a set of adaptive-cluster-sampling boreholes. The determination of which node 5(s) to use as the benchmark will be made by the BC Cribs and Trenches Area Task Lead and will be selected based on the level of contamination measured in the boreholes installed along the node lines. The node 5(s) selected will be associated with one or more of the node 5s on lines where the highest concentrations of Cs-137 are measured using SGL. The first two adaptive-cluster-sampling boreholes associated with each node 5 selected (north and south) will be installed at locations on extensions of the node line 2.1 m (7.0 ft) away from the centerline of the trench (i.e., away from node 5). If Cs-137 activity is detected by the NaI SGL instrument at a concentration greater than 750 pCi/g in the 0 to 4.6 m (0 to 15 ft) bgs interval in any adaptive-cluster-sampling borehole, another borehole will be installed along the same line as the first adaptive-cluster borehole 0.6 m (2 ft) further from the centerline of the trench (i.e., 0.6 m [2 ft] further from node 5). This will continue until an adaptive-cluster-sampling borehole is installed where Cs-137 is not detected at greater than 750 pCi/g in the 0 to 4.6 m (0 to15 ft) bgs interval. If any of the initial adaptive-cluster-sampling boreholes (i.e., those installed 2.1 m [7.0 ft] away from the benchmark borehole) shows no Cs-137 activity greater than 750 pCi/g, then adaptive-cluster-sampling boreholes may be installed closer to the centerline of the trench along the same line as the first adaptive-cluster borehole until Cs-137 activity is seen to approach 750 pCi/g in the 0 to 4.6 m (0 to 15 ft) bgs interval. The BC Cribs and Trenches Area Task Lead will determine how much closer to the benchmark borehole the subsequent adaptive-cluster borehole should be installed when this occurs and whether concentrations measured slightly higher than 750 pCi/g within the first 4.6 m (15 ft) bgs are close enough to define the lateral extent of contamination or if additional boreholes are required. Only SGL measurements will be collected in each of the adaptive-cluster boreholes. No soil samples will be collected from the adaptive-cluster boreholes. The survey locations for all boreholes installed will be associated with analytical results using the sample numbers and field log books.

To calculate an estimate of the total inventory of Sr-90 and Cs-137 in the trench, an estimate of the volume of contaminated soil is required. The location of the berms is not precisely known. Therefore, the node 5s on the node lines that are closest to the berm exclusion area also will be used as benchmark boreholes for adaptive-cluster sampling. Additional adaptive-cluster-sampling boreholes will be installed along the centerline of the trench 1.2 m (4 ft) away from the node 5s that are closest to the berm in each end section of the trench. Additional adaptive-cluster-sampling boreholes will be installed along the center line of the trench 1.2 m (4 ft) away from node 5s on the first and last node lines (i.e. the closest node lines to the berm) in the middle section of the trench (Figure 3-2). These boreholes will be installed in the direction toward the berm until the condition of a Cs-137 concentration greater than 750 pCi/g in the 0 to 4.6 m (0 to 15 ft) bgs interval is not met. The BC Cribs and Trenches Area Task Lead will determine whether concentrations measured slightly higher than 750 pCi/g within the first 4.6 m (15 ft) bgs are close enough to define the lateral extent of contamination or if additional boreholes are required in directions toward the berms.

4.0 HEALTH AND SAFETY PLAN

All field operations will be performed in accordance with appropriate health and safety requirements and procedures. In addition, appropriate documentation will be prepared that will further control site operations. This documentation will include an activity job-hazard analysis, a site-specific health and safety plan, and applicable radiological work permits. Work will be performed in accordance with the site-specific health and safety plans and applicable radiological work permits. The sampling procedures and associated activities will take into consideration exposure-reduction and contamination-control techniques that will minimize the exposure to the sampling team.

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5.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Investigation-derived waste generated by characterization activities will be managed in accordance with WMP-18473, *Waste Control Plan for the BC Crib Area Waste Sites in the 200-TW-1 Scavenged Waste Group Operable Unit*. This plan has been prepared to implement the requirements of the Washington State Department of Ecology, found in Ecology et al., 1999, "Environmental Restoration Program Strategy for Management of Investigation Derived Waste."

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